REMARKS

Claims 1 – 26 are currently pending and under consideration.

The Examiner's Comments on Applicant's Amendment Filed August 13, 2003

The Examiner deemed Applicant's arguments filed August 13, 2003 not persuasive, indicating that (1) the assertion of "a 'finite acceleration' is not found in *Bassett* is not persuasive;" (2) taking the 2^{nd} derivative of Figure 7 temperature chart as shown in Stoddard will yield a finite acceleration; and (3) while Stoddard shows only 2 distinct ramp rates, this clearly could be extended to have as many different ramp rates as desired by one skilled in the art.

Applicant respectfully points out that Bassett is not cited and relied upon by the Examiner in either the First Office Action mailed May 13, 2003 or the outstanding Final Office Action mailed September 9, 2003. For purpose of expediting response to the outstanding Final Office Action, Applicant assumes that the Examiner intended Bassett to be Stoddard. If this assumption is incorrect, Applicant respectfully requests that the Examiner provide the citation for the Bassett reference. Applicant reserves the right to petition withdrawal of finality of the Office Action if Bassett is a newly cited reference in the outstanding Final Office Action.

The Examiner indicated that taking the 2^{nd} derivative of Figure 7 of Stoddard will yield a finite acceleration and that while Stoddard shows only 2 distinct ramp rates (in Figure 7), it can be extended to have as many different ramp rates as desired by one skilled in the art. Applicant respectfully points out that in the First Office Action mailed May 13, 2003, the Examiner discussed Figure 8 of Stoddard which contains 3 distinct ramp rates and Applicant responded by arguing that Figure 8 of Stoddard and its description did not teach or suggest the presently claimed invention. As the Examiner continued to rely on Figure 8 of Stoddard in the outstanding Final Office Action, Applicant presents arguments with reference to Figure 8 of Stoddard. These arguments are equally applicable to Figure 7 of Stoddard.

Claim Rejections under 35 U.S.C. § 102

Claims 19, 20, and 22-26 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Stoddard. Applicant respectfully traverses the rejection.

The Examiner cited FIG. 8 and Col. 1, lines 57-65 of Stoddard as teaching that the temperature of a body is ramped through a temperature acceleration phase wherein the temperature is accelerated at a finite pace, a constant ramp rate phase, and a temperature deceleration phase wherein the temperature is decelerated at a finite pace, to achieve a desired temperature substantially smoothly with minimum oscillation around the desired temperature. Applicant respectfully disagrees the Examiner's reading of Stoddard.

Stoddard does not teach or even suggest the use of *finite* temperature acceleration and deceleration rates. As shown in Figure 8 and described at Col. 16, line 57 through Col. 17, line 9, Stoddard teaches a modified ramp function in which the target setpoint temperature (T_{OUTPUT}) is *instantaneously* increased at a first, minimum ramp rate, R_{MIN} from $T_{INITIAL}$ to a preset percentage (Y% * T_{SP}) of the setpoint temperature (T_{SP}). When T_{OUTPUT} reaches Y% * T_{SP}, the temperature ramp rate is *instantaneously* increased to the maximum ramp rate, R_{MAX}, which is maintained until T_{OUTPUT} reaches a second preset percentage (X% * T_{SP}) of the setpoint temperature (T_{SP}). The ramp rate then *instantaneously* decreases to R_{MIN} until T_{SP} is reached when the temperature ramp rate is *instantaneously* reduced to zero. *The ramp rates are maintained constant in the three phases in Stoddard.* Indeed, Stoddard teaches a temperature control method that is shown in FIG. 1 (prior art) and described in the Background section in the present application. The only difference between Figure 8 of Stoddard and FIG. 1 (prior art) in the present application is that Figure 8 of Stoddard illustrates three constant ramp rate phases instead of a single constant phase shown in FIG. 1 (prior art) for illustrative purpose in the present application. However, both Figure 8 of Stoddard and FIG. 1 (prior art) in the present application share a common limitation: a ramp rate is *instantaneously* increased or decreased to a level and maintained constant at that level in a ramp up phase.

As further illustrated in FIG. 1 (panel 2) in the present application, the ramp rate (first derivative of temperature vs. time or dT/dt, where T is temperature and t is time) for each such constant ramp rate phase is a step function with *infinite* slope at the start and end of the constant ramp rate phase. As a result, the temperature *acceleration rate* (second derivative of temperature or d^2T/dt^2), shown in panel 3 from the top of FIG. 1 (prior art) in the present application, is zero except at the beginning and end of the constant ramp rate phase where it is positive or negative *infinity*, respectively. Similarly, for the temperature program shown in FIG. 8 of Stoddard, the

acceleration or deceleration rate d^2T/dt^2 is *infinite* at the start and end of the program as well as at the beginning and end of the R_{MAX} phase. Taking the 2nd derivative of Figure 7 or 8 of Stoddard will not yield a *finite* acceleration. In short, at every point on the temperature vs. time "curve" where the programmed temperature (T_{OUTPUT}) is discontinuous, *the acceleration is either infinitely positive or infinitely negative.* Because the infinite acceleration and deceleration rates called for by the temperature program are not physically attainable by the physical body being heated, the actual temperature of the body (panel 4 of FIG. 1 (prior art) in the present application) oscillates above and below the programmed temperature as the power supplied to the heating elements (panel 5 of FIG. 1 (prior art) in the present application) also oscillates in response to the unstable temperature profile.

In contrast, the present invention, as recited in Claim 19 and shown in FIGS. 2-7 in the present application, includes a furnace having a temperature controller with control software that accelerates the temperature setpoint from the starting temperature at a *finite* and therefore physically achievable rate as shown in the third panel from the top of FIG. 2. When the programmed temperature reaches the desired end temperature, the temperature ramp rate is then likewise gradually decelerated at a finite rate to a zero temperature ramp rate to smoothly provide a constant ending temperature. FIG. 2 (panel 2) illustrates how this results in a gradual increase in the ramp rate. The upward and downward slopes of the ramp rate in panel 2 of FIG. 2 correspond to the acceleration and deceleration rates shown in panel 3 of FIG. 2, respectively. When the maximum ramp rate is reached, the ramp rate becomes constant with time while the acceleration rate (panel 3 of FIG. 2) is zero. As the target temperature is approached, the acceleration rate becomes *finitely* negative in the *deceleration* phase. The ramp rate (panel 2 of FIG. 2) gradually returns to zero with a negative slope equal to the deceleration rate. As shown in panels 2 and 3 of FIG. 2, in the upward and downward slopes, *the ramp rate varies and the acceleration or deceleration rates is finitely constant.* This is in sharp contrast to Stoddard wherein the acceleration or deceleration rate is *infinite* at the beginning or end of a ramp up phase.

The initial and ending "R_{MIN}" phases shown in Stoddard and identified by the Examiner as temperature "acceleration" and "deceleration" phases are actually nothing more than periods of lower *constant ramp rate.* There is no finite acceleration or deceleration phase as in the

presently claimed invention. As a further illustration of this important distinction, FIG. 8 in Stoddard should be compared with FIG. 1 (prior art) in the present application. Whereas the temperature setpoint vs. time function for a furnace and method of the present invention is continuous and smooth, the temperature setpoint vs. time function taught by Stoddard includes four discontinuities where the temperature ramp rate *instantaneously* changes, thereby requiring instant temperature acceleration. As explained by analogy in the specification at page 6, lines 1-4 of the present application, a physical object cannot be instantaneously accelerated from rest to a non-zero velocity. The same is true for temperature changes in a physical body. Instantaneous acceleration and/or deceleration of the temperature ramp rate is not physically possible. *The presently claimed invention solves this problem by accelerating the programmed temperature at a finite, physically attainable rate that results in closer conformance of the actual body temperature to the programmed temperature profile (panel 4 of FIG. 2) and substantially fewer and less dramatic oscillations in the power load for the heating elements (panel 5 of FIG. 2).*

Therefore, Applicants respectfully request reconsideration of the rejection of Claim 19 under 35 U.S.C. § 102(e) over Stoddard. Claims 20 and 22-26 depend on Claim 19 and recite further limitations. Claims 20 and 22-26 are therefore patentable over Stoddard for at least the same reasons.

Claim Rejections under 35 U.S.C. § 103

Claims 1 – 18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Stoddard in view of Petit.

Dependent Claims 3 and 12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Stoddard in view of Petit and further in view of Davis.

Claim 21 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Stoddard in view of Davis.

Applicant respectfully traverses each of the above rejections.

As discussed above, Stoddard does not teach a method of temperature control that includes the use of *finite* temperature acceleration and deceleration rates according to the presently claimed invention.

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The Examiner cited Petit as "showing the use of 'Approach Control.' (Col 2 lines 30-40) to prevent overshoot." Petit teaches a method for self-tuning a Proportional Integral-Derivative controller to react to new input parameters such as new heater elements and/or a heated body with different thermal inertia. A system is subjected to perturbations under automated feedback control and system control parameters are determined based on responses to the perturbations. Petit does not provide any teaching or suggestion that would have lead one of skill in the art at the time of the present invention to consider the use of *finite* acceleration and/or deceleration rates in general or more specifically to modify the teachings of Stoddard to obtain the instantly claimed invention as recited in independent Claims 1 and 10.

Davis teaches the use of radiant heat lamps to raise the temperature of semiconductor wafers during processing. However, Davis does not teach or suggest in any way the use of *finite* temperature acceleration and deceleration rates in a method of heating a body in a furnace as claimed in the instant application.

Rejected Claims 2 – 18 depend from Claims 1 and 10, respectively , and therefore include the patentable limitations of the base claims. Reconsideration of the rejection of Claims 2 – 18 and 21 under 35 U.S.C. §103(a) is therefore respectfully requested.

Based on the foregoing, Applicants respectfully submit that claims 1 - 26 are in condition for allowance. An early indication of the same is therefore kindly requested. If any matters can be resolved by telephone, the Examiner is invited to call the undersigned attorney at the telephone number listed below. The Commissioner is authorized to charge any additional required fees, or credit any overpayment, to Dorsey & Whitney LLP Deposit Account No. 50-2319 (Order No. A-69448/MSS/ (463035-00033)).

Respectfully submitted,

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